MEMO Number: UMBC-CMPE451-SOW-Final
DATE: February 17, 2023
TO: E.F.C. LaBerge
FROM: UHDRTZ
SUBJECT: Statement of Work CMPE 451

1 INTRODUCTION

1.1 Project Description

The Ultra Hi-Definition Real Time Zoetrope (UHDRTZ) is an interactive art installation based around a disc-shaped artwork that appears to animate when rotated at the correct speed. To achieve this effect, a live video feed of the artwork is rotated digitally, controlled by a hand crank. An overview of the system is shown in Figure 1.1.1.

This project is an improvement to an existing system, originally released as the Real Time Zoetrope (RTZ), followed by two HD revisions HDRTZ and HDRTZ2.

A rotary encoder sends signals to an Arduino Nano BLE (Bluetooth Low Energy). The Arduino is connected via Bluetooth to an Nvidia Jetson TX2 FPGA. The Bluetooth connection is automatic and will pair when both the FPGA and Arduino are powered on.

The FPGA is provided input from two sources and has one output. The FPGA receives location input from the Bluetooth Arduino and visual input from a 4K USB 3.0 Camera. The FPGA outputs the visual data to either a projector or monitor through an HDMI cable as shown in Figure 1.1.2.

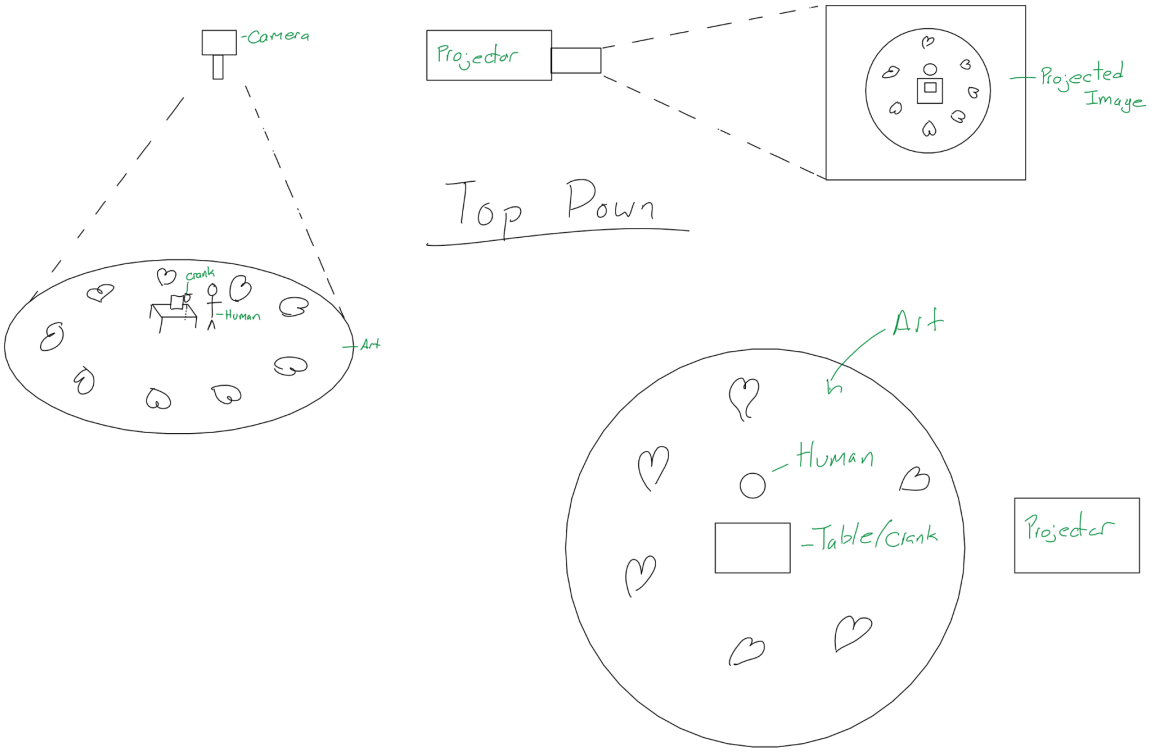

Figure 1.1.1: Mission Scenario Diagram

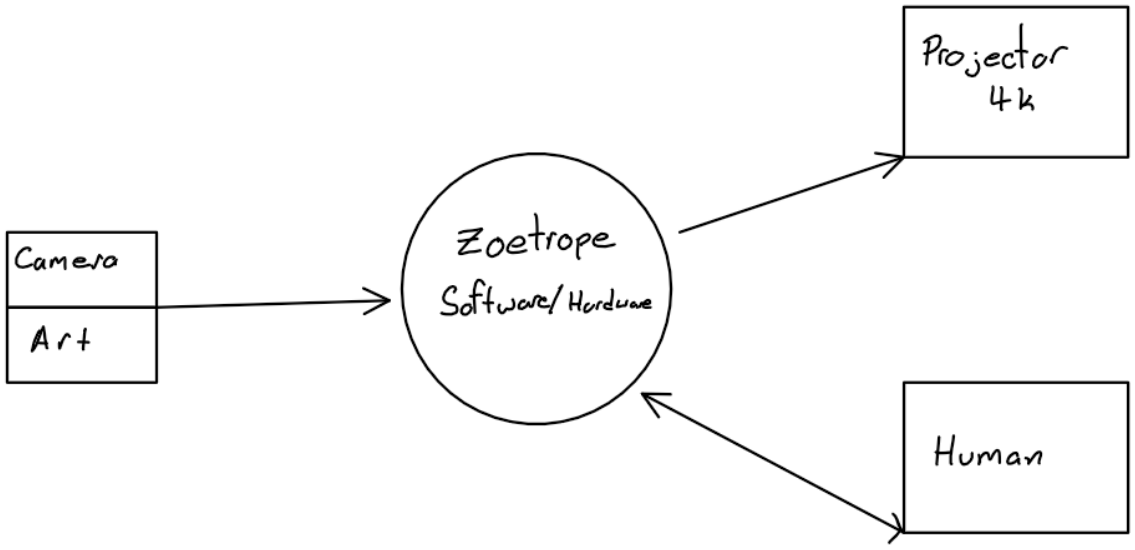

Figure 1.1.2: System Boundary Diagram

1.2 External Standards

1.2.1 USB-2.0 male to USB Micro male connection. IEC 62680 and EC 62680-1
1.2.2 Bluetooth Light Energy. IEEE 802.15.1
1.2.3 AC Power Adapter. IEC 62700
1.2.4 HDMI-2.1 EIA/CEA-861 standard

1.3 Referenced Documents

1.3.1 HDRTZ2 team's code

1.3.2 Demonstration of the system from 2016:
https://userpages.umbc.edu/~dyer/eric-dyer---girona-octopi.html

1.4 Overview of Document

This document is an overview of the tasks that will need to be completed in order to produce a finished product. The document will cover all specifications and desired functionality of the project as well as detailing how specific tasks will be completed and tested.

2 STATEMENT OF WORK

2.1 Improve System Speed

The output resolution of the system is limited by the maximum rate at which the system can process the video signal. In order to increase the resolution and create a smooth user experience, the team shall research the existing code, design new methods and functions, test, and integrate these updates into the existing HDRTZ system.

2.1.1 Find Bottlenecks

The team shall thoroughly examine and evaluate the crank system, Aduino-FPGA interface, camera resolution, software run times, and any other relevant HDRTZ design elements or characteristics to determine which elements are limiting performance.
Deliverable: List of components that are limiting performance.

2.1.2 Eliminate Bottlenecks

Based on the analysis and evaluation of Task 2.1.1, the team shall modify the existing design to reduce inefficiencies, resulting in better performance.
Deliverable: A smoother-running system that can handle 4K.

2.2 Audio

The team shall implement, troubleshoot, and verify functionality of the audio output feature.

2.3 UI (local)

The team shall develop and test a resizable and mobile user interface for cropping and moving the image to be displayed.

2.4 Service (run on boot)

The team shall research, design, and implement a routine for automatically starting and running the software upon powering the system.

2.5 4K Input/Output

The group shall verify that the UHDRTZ system meets input and output requirements of the 4K resolution as detailed in the SRS.

2.6 Power Arduino

The group shall research, design, implement, test, and integrate a replacement for the UHDRTZ Arduino power system.
Note: Currently, the Arduino is powered by a battery pack containing 4 AA batteries. The team aims to make the Arduino power unit more long term by either using an AC power source or an rechargeable battery pack with a longer battery life than the previous power options.
Deliverable: A power source that is compatible with the Arduino.

2.7 Improve Usability

The ease of setup and breakdown of the system as a whole is challenging for persons who are not familiar with the system. To make ease of setup better, the team shall write a complete user guide with instructions for setup and troubleshooting.
Deliverable: Complete User Guide with setup, troubleshooting, and system descriptions sections.

2.8 Increase Physical Robustness of System

The team shall design, develop, and 3D print and physical mount for the Arduino in the crank housing to prevent any damage to the Arduino during transportation and general use.
Deliverable: Housing to keep the Arduino fixed inside the crank housing shall be developed and 3D printed.

2.9 Testing

The team shall test each interface between different sections of the hardware and software systems. To meet this requirement the team shall use different animations and setups to test the flow of the generated frames and verify the 4K output.

The team shall configure the resolution of the rotary encoder for fine grained control of image. The team shall optimize the data rate between rotary encoder to arduino to FPGA.

For usability the team shall configure the web app frontend to be straightforward and simple to use.

3 PROJECT PLANNING

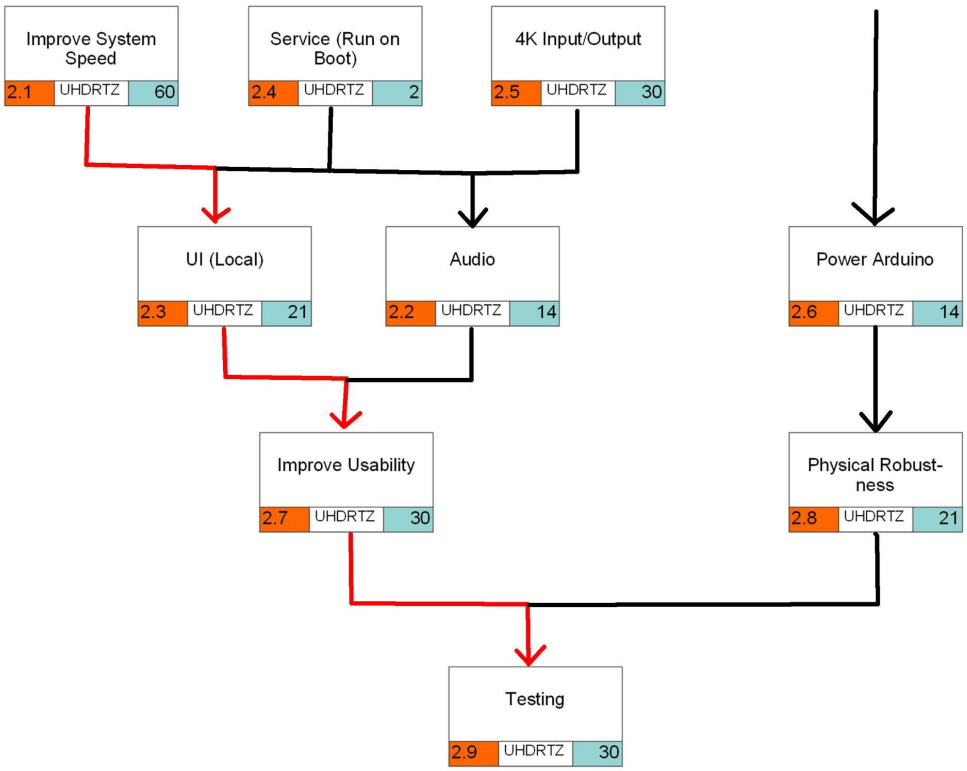

Figure 3.1: Task Network Diagram (Critical Path Shown in Red)

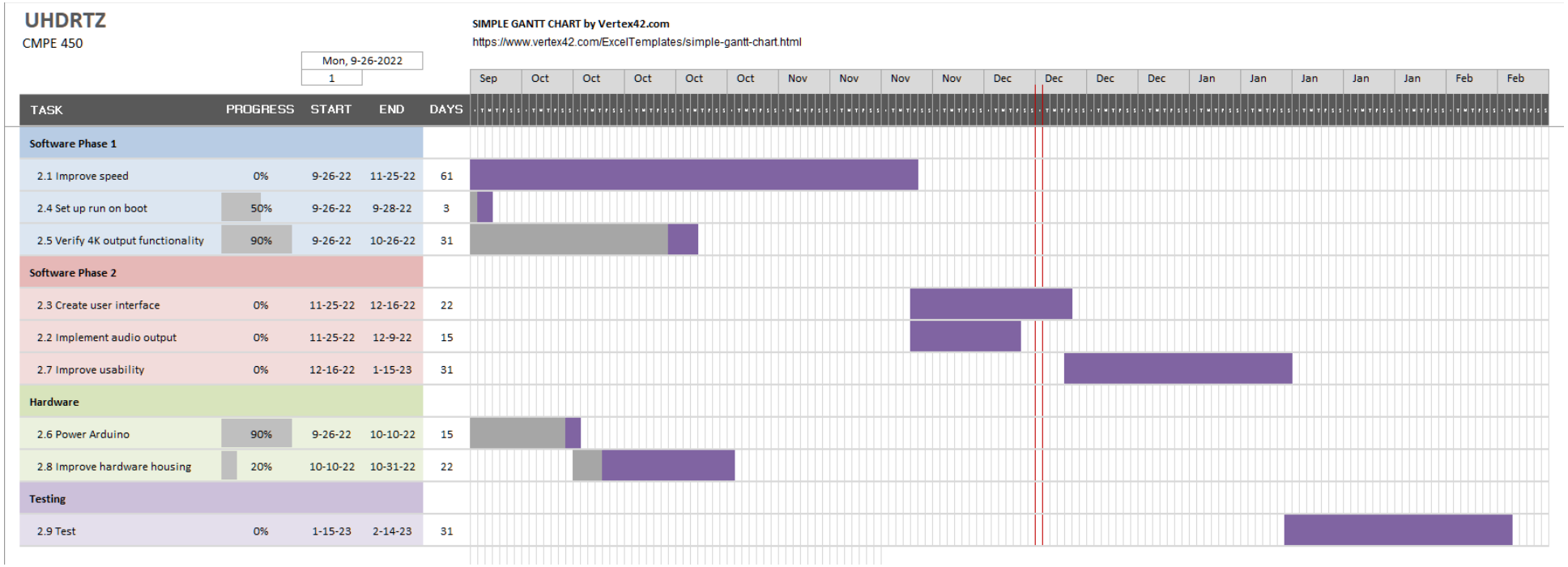

Figure 3.2: Task Gantt Chart

4 DELIVERABLES

1. Statement Of Work
    a. Overview of the tasks that will need to be completed in order to produce a finished product. The document will cover all specifications and desired functionality of the project as well as detailing how specific tasks will be completed and tested.
    b. **Due:** 2023-02-17
2. System Requirements Specification
    a. Overview of the technical requirements and design choices of the UHDRTZ system. This is the introduction to the project and covers all design and testing considerations.
    b. Due: 2023-02-17
3. Demo
    a. Demonstration of final project.
    b. Due: TBD
4. 4K Output
5. Clear Audio Output
6. Arduino AC Power Supply
7. Arduino Mounting Bracket
8. Camera Mount and Shield
9. Crank Resistance Mechanism
10. User Interface
11. Color and Effects Control
12. Run on Boot
13. Housing for Camera
14. Housing for Arduino
15. User Guide